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ABSTRACT

An experiment investigated whether adapting to individual differences in a finely-graded, single-skill program improved performance. Three types of item sequences were used. The linear group received the program in its original linear sequence. Each member of the branched group entered the program at the point determined by his performance on the branching items. Each yoked subject was paired randomly with a member of the branched group and received the item sequence, including branching items, determined by the performance of his branched partner. The yoked group provided a control for the adapting process. The only difference between the branched and yoked groups was that the item sequences were adaptive to and appropriate for the branched subjects and not for the yoked subjects. The branched and yoked groups did not differ on any of the dependent variables. Thus no gain could be attributed to the adaptive process. The results suggested that the merits of adapting to individual differences should no longer be accepted on face validity. (JK)

The Yoked Control for Assessing Branching Effects: Does Individualization Help?

James G. Holland and Jeanne S. Hoffman

Individualization of instruction via branching or adapting is the current vogue in educational technology and is featured prominently in most literature concerning theories of instruction. Indeed, this concept lies at the core of multi-million dollar implementation activities in "individually prescribed instruction" and in computer-assisted instruction. In individualized materials or programs there is a set ofcommon behavior objectives or terminal behaviors toward which all students are directed. Embedded within the materials are criterion-referenced tests which diagnose the individual student's strengths or weaknesses in aptitude, achievement or learning style. Depending on this diagnosis, the student is presented with appropriate materials en route toward the common behavioral objectives. In general, the case for adapting rests on the supposition that adapting to individual differences provides more efficient teaching in terms of greater achievement and/or more rapid progress. Such adaptive programs should not be confused with another current trend which the word adaptive might suggest, namely the student-oriented or open classroom in which the activities of the student depend to a sizable extent on their own interests or desires. In this case, the teaching objectives are not always identical for each student, nor is efficiency considered an appropriate criterion for evaluation of their teaching objectives.

THERE HAS BEEN DISTRESSINGLY LITTLE EXPERIMENTAL EVALUATION OF THE ADAPTIVE VARIABLE ITSELF, OR OF THE FACTORS WHICH MIGHT DETERMINE ITS DEGREE OF EFFECTIVENESS. INDEED, WITH RARE EXCEPTIONS (CF. COOLEY, 1971) THERE HAS BEEN LITTLE EXPRESSION OF INTEREST IN EVALUATING ANY VARIABLES IN MATERIALS WHICH ADAPT TO INDIVIDUAL DIFFERENCES. THIS IS NOT TO SAY THAT THERE HAS BEEN NO EVALUATION OF THE ADAPTIVE PROGRAMS THEMSELVES. IT IS COMMONLY THE CASE THAT THESE EVALUATIONS PROVIDE DATA ON THE OVERALL EFFECTIVENESS OF THE MATERIALS. IT IS ALSO TRUE THAT IN SOME INSTANCES THERE ARE COMPARISONS WITH SO-CALLED CONVENTIONAL INSTRUCTION. HOWEVER, SUCH BROAD COMPARISONS ARE NOT SUFFICIENTLY ANALYTIC TO BUILD A SUITABLE TECHNOLOGY OF EDUCATION. THE KEY FACTOR TO WHICH SUCCESS IS ATTRIBUTED (IF IT IS ATTAINED) IS THE ADAPTIVE FEATURE WHEREBY THE SEQUENCE OF MATERIALS A STUDENT RECEIVES DEPENDS UPON THE OUTCOME OF THE CRITERION-REFERENCED TESTS. HOWEVER, THE MATERIALS DIFFER FROM CONVENTIONAL MATERIALS IN A NUMBER OF OTHER WAYS. GENERALLY THE STUDENTS WORK ALONE, AND GENERALLY THERE IS A HIGH DENSITY OF ACTIVE RESPONSES. IN ADDITION, THERE IS USUALLY A QUITE DIFFERENT RELATIONSHIP BETWEEN STUDENT AND TEACHER. OFTEN THE ADAPTIVE PROGRAM HAS A CLOSER RESEMBLANCE TO THE MATERIALS USED IN TESTING THE OUTCOME THAN DOES THE MATERIAL IN THE COMPARISON PROGRAM. THUS, WHILE OVERALL EVALUATION OF A PROGRAM IS IMPORTANT FOR PRACTICAL CONSIDERATIONS, GROSS COMPARISONS WITH CONTROL GROUPS DO NOT INDICATE HOW MUCH IS GAINED THROUGH THE ADAPTIVE PROCEDURE ITSELF. IT IS NOT POSSIBLE TO EVALUATE FACTORS AS OBVIOUS AS THE DIFFERENTIAL EFFECTIVENESS OF THE DIFFERENT COLLECTIONS OF INSTRUCTIONAL UNITS SEEN BY SUBJECTS IN THE VARIOUS EXPERIMENTAL GROUPS.

A PROPER CONTROL FOR ADAPTATION AS AS EXPERIMENTAL VARIABLE WOULD BE A CONTROL GROUP WHICH RECEIVED EACH OF THE INDIVIDUAL SEQUENCES FOUND IN THE INDIVIDUALIZED GROUP, BUT WITHOUT THE SEQUENCES BEING

ADAPTED TO THE NEEDS OF THE CONTROL SUBJECTS. THIS REQUIREMENT CAN BE MET BY A "YOKED" CONTOL GROUP IN WHICH EACH CONTROL SUBJECT IS PAIRED WITH AN EXPERIMENTAL SUBJECT. EACH SUBJECT IN THE YOKED CONTROL GROUP RECEIVES A SEQUENCE OF MATERIAL IDENTICAL TO THE SEQUENCE SEEN BY HIS BRANCHED MATCH-MATE WITH THE RESULT BEING THAT THE YOKED GROUP AS A WHOLE EXPERIENCES SEQUENCES OF ITEMS IDENTICAL TO THE ITEM SEQUENCES OF THE BRANCHED GROUP, BUT NOT NECESSARILY APPROPRIATE FOR THE NEEDS OF THE YOKED GROUP. THUS THE YOKED GROUP PROVIDES A CONTROL FOR THE ADAPTIVE PROCESS. THE ONLY DIFFERENCE BETWEEN THE BRANCHED AND YOKED GROUPS WOULD BE THAT THE ITEM SEQUENCE IS ADAPTIVE TO AND APPROPRIATE FOR THE BRANCHED SUBJECT, BUT NOT FOR THE YOKED SUBJECT.

THE PURPOSE OF THE PRESENT STUDY IS TO MEASURE THE GAIN THAT CAN BE ATTRIBUTED TO ADAPTING TO INDIVIDUAL DIFFERENCES WHEN A MAXIMALLY EFFICIENT BRANCHING PROCEDURE (THE BINARY SEARCH BRANCHING PROCEDURE) IS USED TO PLACE SUBJECTS WITHIN A LINEAR PROGRAM. IN ADDITION, A THIRD GROUP WHO EXPERIENCED THE COMPLETE LINEAR PROGRAM WAS USED TO PROVIDE A MEASURE OF OVERALL EFFECTIVENESS.

METHOD

SUBJECTS: THIRTY-THREE CHILDREN BETWEEN THE AGES OF 6.6 AND 7.11 COMPLETED THE PROGRAM. THEY WERE DRAWN FROM THREE SCHOOLS AND REFLECTED A WIDE RANGE OF SOCIO-ECONOMIC CLASSES. EACH S WAS RANDOMLY ASSIGNED TO ONE OF THREE GROUPS.

AN ADDITIONAL NINETEEN SUBJECTS WHO STARTED THE PROGRAM WERE UNABLE TO COMPLETE IT FOR A VARIETY OF REASONS (COMPUTER BREAK-DOWN, VACATIONS, INABILITY TO WORK TOUCH SENSITIVE SCREEN, INABILITY TO SOLVE ITEMS, LACK OF KNOWLEDGE OF COLOR, UNCOOPERATIVENESS). SUBJECTS WHO PERFORMED BELOW CHANCE OR PERFECTLY ON THE PRETEST WERE EXCLUDED FROM THE STUDY, BUT WITH THIS LIMITATION A WIDE RANGE OF INDIVIDUAL DIFFERENCES WAS DESIRED AND OBTAINED.

APPARATUS: A PDP 7/9 COMPUTER PROVIDED ON-LINE CONTROL OF THE PROCEDURES. THE MATERIAL WAS PRESENTED ON AN 18" x 18" TOUCH SENSITIVE SCREEN DIVIDED INTO A 9 x9 MATRIX. A MARBLE DISPENSER WAS USED FOR DISPENSING MARBLES USED AS TOKENS FOR REINFORCEMENT. PROGRAM ITEMS WERE PHOTOGRAPHED ON 35 MM SLIDES WHICH WERE BACK PROJECTED ONTO THE TOUCH SENSITIVE SCREEN BY A RANDOM ACCESS 950 CAROUSEL SLIDE PROJECTOR (CF. KATSUKI AND FITZHUGH, 1971).

THE TEACHING PROGRAM WAS A 256 ITEM LINEAR PROGRAM TO TEACH INDUCTIVE REASONING IN LOGIC AND HAS BEEN USED IN PREVIOUS INVESTIGATIONS (CF. SKINNER, 1961; HOLLAND, 1962). THE PROGRAM HAS A TESTED ERROR RATE OF LESS THAN 10%. THE PRETEST AND POSTTEST WERE COMPOSED OF 21 REPRESENTATIVE ITEMS FROM THE PROGRAM WHICH WERE ARRANGED IN A RANDOM ORDER.

PROGRAM ITEMS (AS WELL AS PRE AND POSTTEST ITEMS) CONSISTED OF A ROW OF BOTTLE SHAPES WHICH, THROUGH VARIATIONS IN COLOR AND DIRECTION, FORMED A PATTERN. (SEE FIGURE 1) BENEATH THIS ROW WERE SPACED FIVE ALTERNATIVES FROM WHICH THE S CHOSE HIS ANSWER. THE S HAD TO INDUCE WHICH BOTTLE CAME NEXT IN THE SERIES. THE PATTERN OF THE BOTTLES VARIED FROM SIMPLE, VARYING IN ONLY ONE DIMENSION, TO MORE COMPLEX AS THE PROGRAM PROGRESSED.

TEN DEMONSTRATION ITEMS WERE USED WHICH WERE INTENDED TO TEACH USE OF THE TEACHING MACHINE. THE DEMONSTRATION ITEMS DIFFERED FROM PROGRAM ITEMS ONLY IN THAT THE SHAPES USED WERE CIRCLES, TRIANGLES, SQUARES AND ARROWS. ALL SHAPES USED IN THE PROGRAM WERE CUT FROM VINYL AND WERE RED, ORANGE, YELLOW OR WHITE. THE SHAPES WERE PHOTOGRAPHED AGAINST A DARK BACKGROUND.

PROCEDURE: ADAPTATION TO INDIVIDUAL DIFFERENCES WAS ACCOMPLISHED VIA THE BINARY SEARCH METHOD. THE BINARY SEARCH PROCEDURE PLACED SUBJECTS IN THE LINEAR SEQUENCE BY BEGINNING WITH THE MIDDLE ITEM AND BISECTING

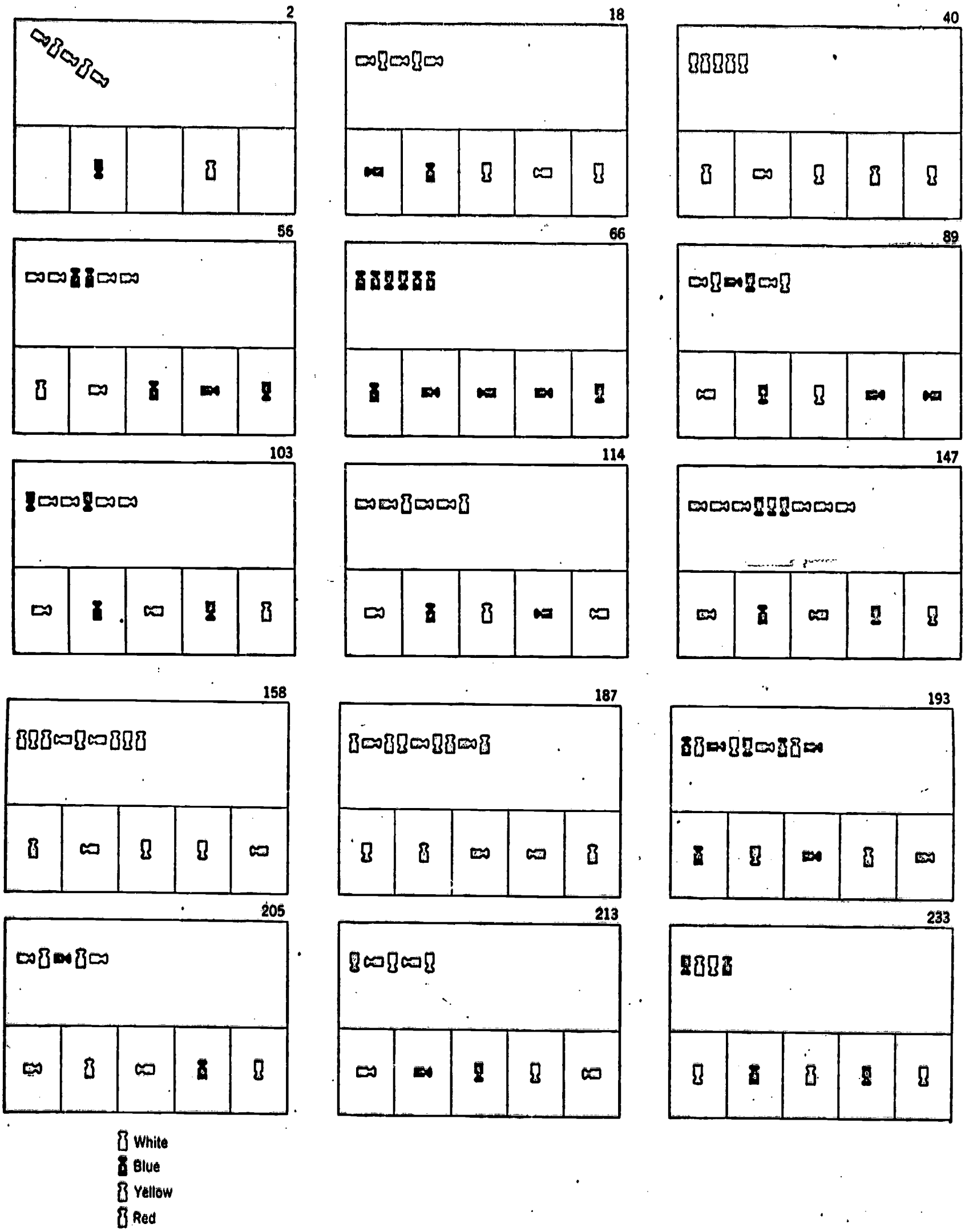


Fig. 1: Sample items from the inductive reasoning experiment. The number above each item indicates its position in the 234-item sequence. The correct alternatives (in order) of these items are 4, 3, 3, 3, 5, 4, 4, 1, 4, 2, 1, 2, 4, 5, and 1.

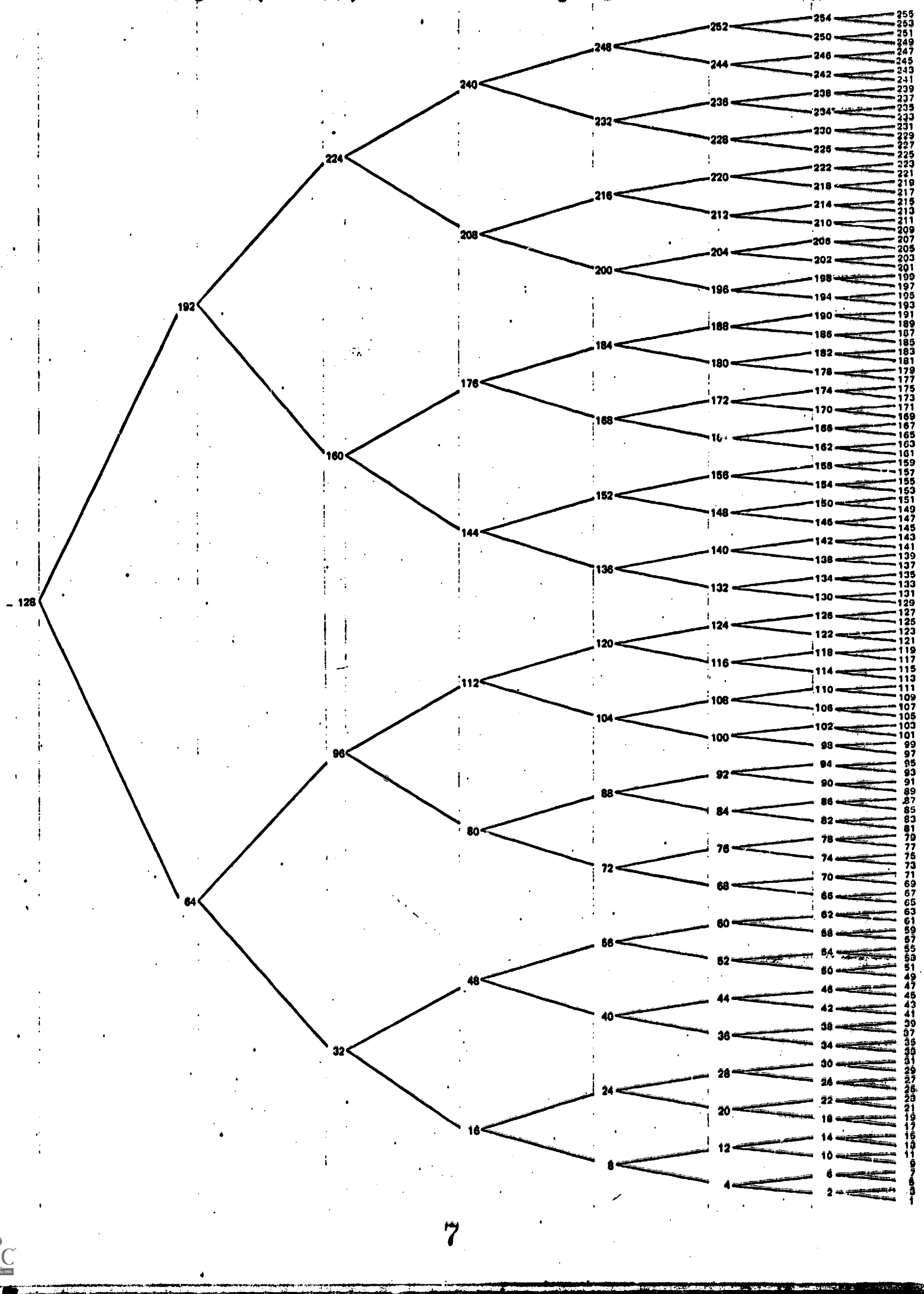
DISTANCES FORWARD OR BACKWARD AFTER CORRECT OR INCORRECT RESPONSES. (SEE FIGURE 2) THREE GROUPS OF 11 SUBJECTS EACH EXPERIENCED THREE DIFFERENT TYPES OF ITEM SEQUENCES. THE LINEAR GROUP RECEIVED THE PROGRAM IN ITS ORIGINAL LINEAR SEQUENCE. THE BRANCHED GROUP RECEIVED THE MAXIMALLY EFFICIENT BINARY SEARCH PROCEDURE SO THAT EACH SUBJECT REACHED HIS PROPER PLACE IN THE LINEAR SEQUENCE AT THE POINT DETERMINED BY HIS PERFORMANCE ON THE BRANCHING ITEMS-- A SEQUENCE ADAPTED TO HIS SKILL. THE THIRD GROUP WAS A YOKED CONTROL GROUP IN WHICH EACH INDIVIDUAL WAS PAIRED RANDOMLY WITH A SUBJECT IN THE BRANCHED GROUP AND RECEIVED A SEQUENCE IDENTICAL TO HIS MATCH-MATE'S AND DETERMINED BY HIS MATCH-MATE'S PERFORMANCE.

THE PRINCIPAL MEASURE WAS A COMPARISON OF DIFFERENCES IN PRETEST AND POSTTEST PERFORMANCE. ADDITIONAL MEASURES WERE THE NUMBER OF ITEMS IN THE LINEAR PORTION OF THE PROGRAM ON WHICH ERRORS WERE MADE, TOTAL NUMBER OF ERRORS INCLUDING PERSEVERATIVE ERRORS, AND TIME TO COMPLETE THE PROGRAM.

THE SUBJECTS WERE BROUGHT TO THE EXPERIMENTAL ROOM BY THE EXPERIMENTER AND WERE SEATED ON A CHILD-SIZED CHAIR IN FRONT OF THE TOUCH SENSITIVE SCREEN. THE ROOM LIGHTS WERE TURNED OFF TO PROVIDE BETTER VISIBILITY OF THE SCREEN AND ITEM. AFTER THE FIRST DEMONSTRATION ITEM APPEARED, BRIEF VERBAL INSTRUCTIONS WERE GIVEN TO THE S.

THE S WAS FIRST REQUIRED TO TOUCH EACH OBJECT ON THE TOP ROW IN SEQUENCE FROM LEFT TO RIGHT, A TYPE OF FORCED OBSERVING RESPONSE. ONLY AFTER HE HAD TOUCHED ALL THE OBJECTS IN SEQUENCE WAS HE ABLE TO SELECT THE OBJECT IN THE BOTTOM ROW WHICH COMPLETED THE SEQUENCE. IF HE TOUCHED AN OBJECT OUT OF SEQUENCE OR IF HE SELECTED THE WRONG ANSWER, THE SCREEN BLACKED OUT FOR ONE SECOND. WHEN THE STIMULI REAPPEARED, S STARTED THE COMPLETE SEQUENCE AGAIN. A CORRECT RESPONSE RESULTED IN A TONE ACCOMPANIED BY A GREEN LIGHT AND A MARBLE DROPPING FROM A HOLE NEXT TO THE TOUCH SENSITIVE

Figure 2. Binary Search Branching Procedure



SCREEN INTO A CLEAR PLASTIC BOX. ALL ITEMS IN THE PROGRAM, AS WELL AS THE PRETEST AND POST TEST, OPERATED IN THIS MANNER--EXCEPT THAT NO MARBLE WAS GIVEN FOR CORRECT RESPONSES ON THE PRETEST AND POSTTEST. A CORRECTION PROCEDURE WAS USED IN THE DEMONSTRATION ITEMS AND PROGRAM ITEMS IN BOTH THE BRANCHING AND LINEAR PHASES SO THAT THE NEXT ITEM WAS NOT PRESENTED UNTIL THE CORRECT RESPONSE WAS MADE. THEREFORE, MULTIPLE ERRORS ON AN ITEM WERE POSSIBLE. PRE AND POSTTEST ITEMS DIFFERED FROM PROGRAM ITEMS IN THAT ANY RESPONSE TO THE BOTTOM ROW TERMINATED THAT ITEM AND RESULTED IN THE APPEARANCE OF THE NEXT ITEM. HENCE, DURING TESTS THERE WAS NO DIFFERENTIAL REINFORCEMENT. ONLY INCORRECT TOUCHES TO THE BOTTOM ROW WERE COUNTED AS ERRORS. NO ERRORS WERE RECORDED FOR DEMONSTRATION ITEMS.

THE GENERAL ITEM SEQUENCE FOR EACH SUBJECT WAS DETERMINED BY HIS GROUP ASSIGNMENT. THE ITEM SEQUENCE FOR THE BRANCHED S WAS DETERMINED BY HIS PERFORMANCE ON THE BRANCHING ITEMS WHILE THE ITEM SEQUENCE FOR A YOKED S DEPENDED ON THE PERFORMANCE OF THE BRANCHED S WITH WHICH HE HAD BEEN PAIRED.

THE PROGRAM REQUIRED MORE THAN ONE SESSION FOR SOME Ss TO COMPLETE SINCE NO SESSION WAS MORE THAN 40 MINUTES IN LENGTH. HOWEVER, THE FIRST SESSION FOR ALL Ss LASTED AT LEAST UNTIL THEY HAD ENTERED THE PROGRAM.

RESULTS

PRETEST TO POSTTEST GAINS: THE DIFFERENCE BETWEEN PRETEST AND POSTTEST PERFORMANCE IS ATTRIBUTABLE TO THE PROGRAM ITEM SEQUENCE WHICH THE S HAD EXPERIENCED. TABLE 1 SHOWS THAT THE LINEAR GROUP HAD THE GREATEST

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INSERT TABLE 1 ABOUT HERE

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MEAN REDUCTION OF ERRORS (6.5), THE BRANCHED HAD A MEAN REDUCTION OF 3.5 ERRORS, AND THE YOKED GROUP HAD THE LEAST MEAN REDUCTION OF ERRORS, 1.45. THE ASSUMED PRIMACY OF ADAPTING TO INDIVIDUAL DIFFERENCES WOULD LEAD TO

TABLE 1

Mean and Standard Deviation for Differences in Number of Errors from the Pretest to the Posttest for the Linear, Branched and Yoked Groups

		Linear	Branched	Yoked
Pretest-posttest differences in number of errors	M	6.5	3.5	1.45
	S	4.4	3.9	3.9

AN ASSUMPTION THAT THE PRETEST-POSTTEST GAIN SCORE SHOULD REFLECT A DIFFERENCE BETWEEN THE BRANCHED GROUP AND THE YOKED CONTROL GROUP. HOWEVER, A STATISTICAL EVALUATION OF INDIVIDUAL GROUP COMPARISONS INDICATES NO HINT OF STATISTICALLY SIGNIFICANT DIFFERENCES BETWEEN THESE TWO GROUPS. ALTHOUGH INDIVIDUAL GROUP COMPARISONS DID REVEAL A STRONG SUGGESTION OF OF A DIFFERENCE BETWEEN THE LINEAR AND THE BRANCHED GROUPS, THIS DIFFERENCE DID NOT REACH THE TRADITIONAL LEVEL FOR STATISTICAL SIGNIFICANCE ($.10 < p < .25$). HOWEVER, THE YOKED AND LINEAR GROUPS DIFFERED SIGNIFICANTLY WITH $.01 < p < .025$.

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INSERT FIGURES 3,4, AND 5 ABOUT HERE

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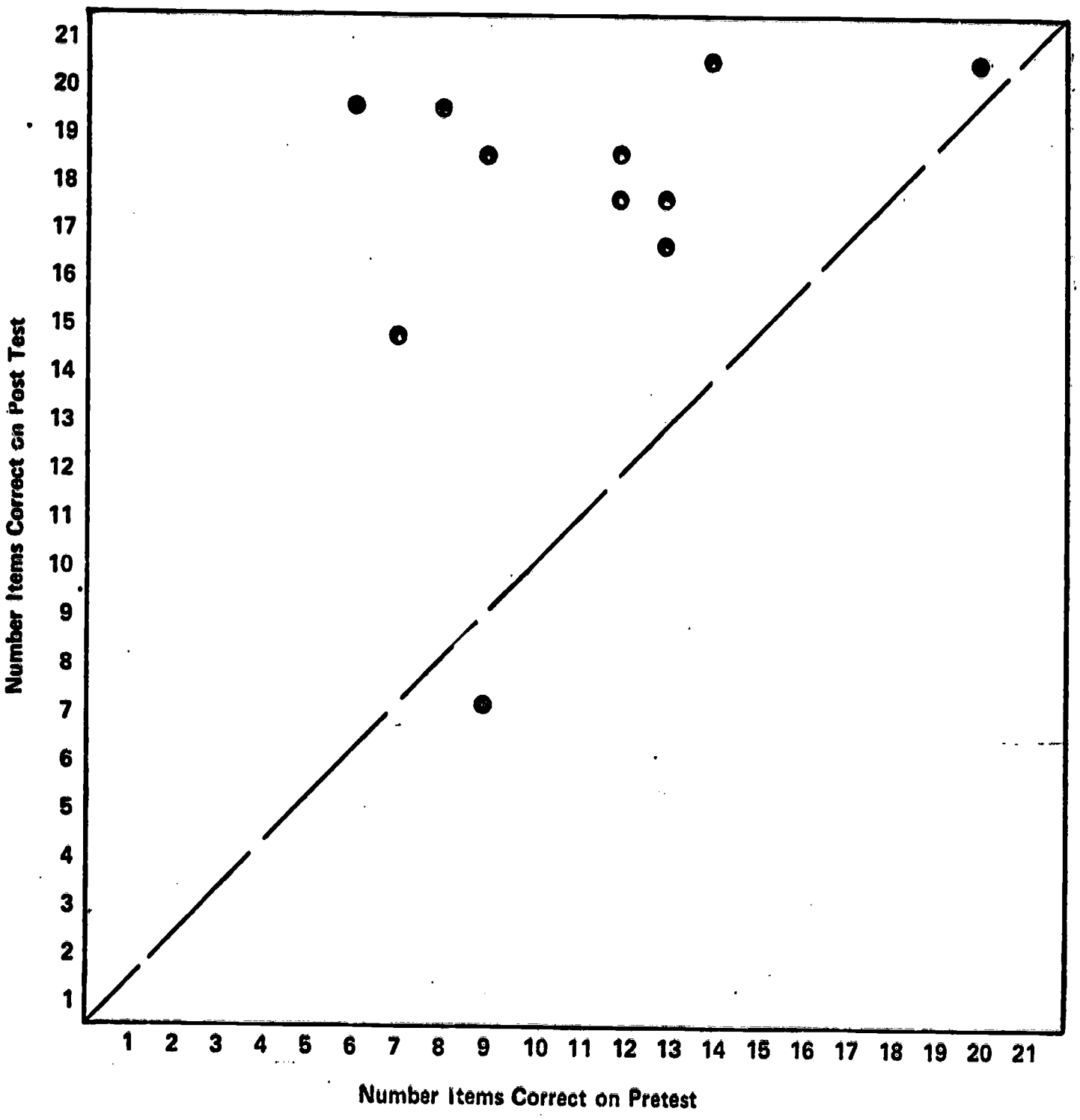
THE NATURE OF THESE DIFFERENCES IS CLEAR IN THE INDIVIDUAL DATA PRESENTED IN FIGURES 3,4,AND 5 AS SCATTER PLOTS RELATING PRE AND POSTTEST SCORES. IN THE LINEAR GROUP (FIG.3) THE SCORES ARE WIDELY DISTRIBUTED FOR THE PRETEST, RANGING FROM 6 TO 20, BUT TEND TO CLUSTER TOWARD THE TOP OF THE GRAPH, INDICATING HIGH POSTTEST PERFORMANCE. ANY S WHO SCORED THE SAME ON BOTH TESTS WOULD FALL ON THE DIAGONAL.LIDE, WHILE AN S WHO HAD A LOWER SCORE ON THE POSTTEST THAN ON THE PRETSET WOULD FALL BELOW THIS LINE. ONLY ONE S IN THE LINEAR GROUP SCORED LOWER ON THE POSTTEST.. ALL OTHER LINEAR Ss HAD POSTTEST SCORES 17 OR ABOVE. THIS GRAPH REPRESENTS HOW A GOOD PROGRAM SHOULD EFFECT CRITERION PERFORMANCE, I.E., REGARDLESS OF PRETEST PERFORMANCE, POSTTEST PERFORMANCE IS HIGH.

FIGURE 4 SHOWS THAT THE BRANCHED GROUP ALSO HAD A WIDE DISTRIBUTION OF PRETEST SCORES,7 TO 18. HOWEVER, THE POSTTEST SCORES WERE NOT CLUSTERED NEAR THE TOP OF THE POSTTEST AS WERE THE LINEAR GROUP POSTTEST SCORES. THE YOKED GROUP (SHOWN IN FIG. 5) LIKEWISE HAD A WIDE DISTRIBUTION OF PRETEST SCORES, 6 TO 19, BUT FAILED TO CLUSTER NEAR THE TOP OF THE POSTTEST. BOTH THE BRANCHED AND YOKED GROUPS HAD 7 Ss IMPROVE, 2 Ss



Linear

FIGURE 3

Number of items correct on post test as a function of number of items correct on the pretest for the Linear group.

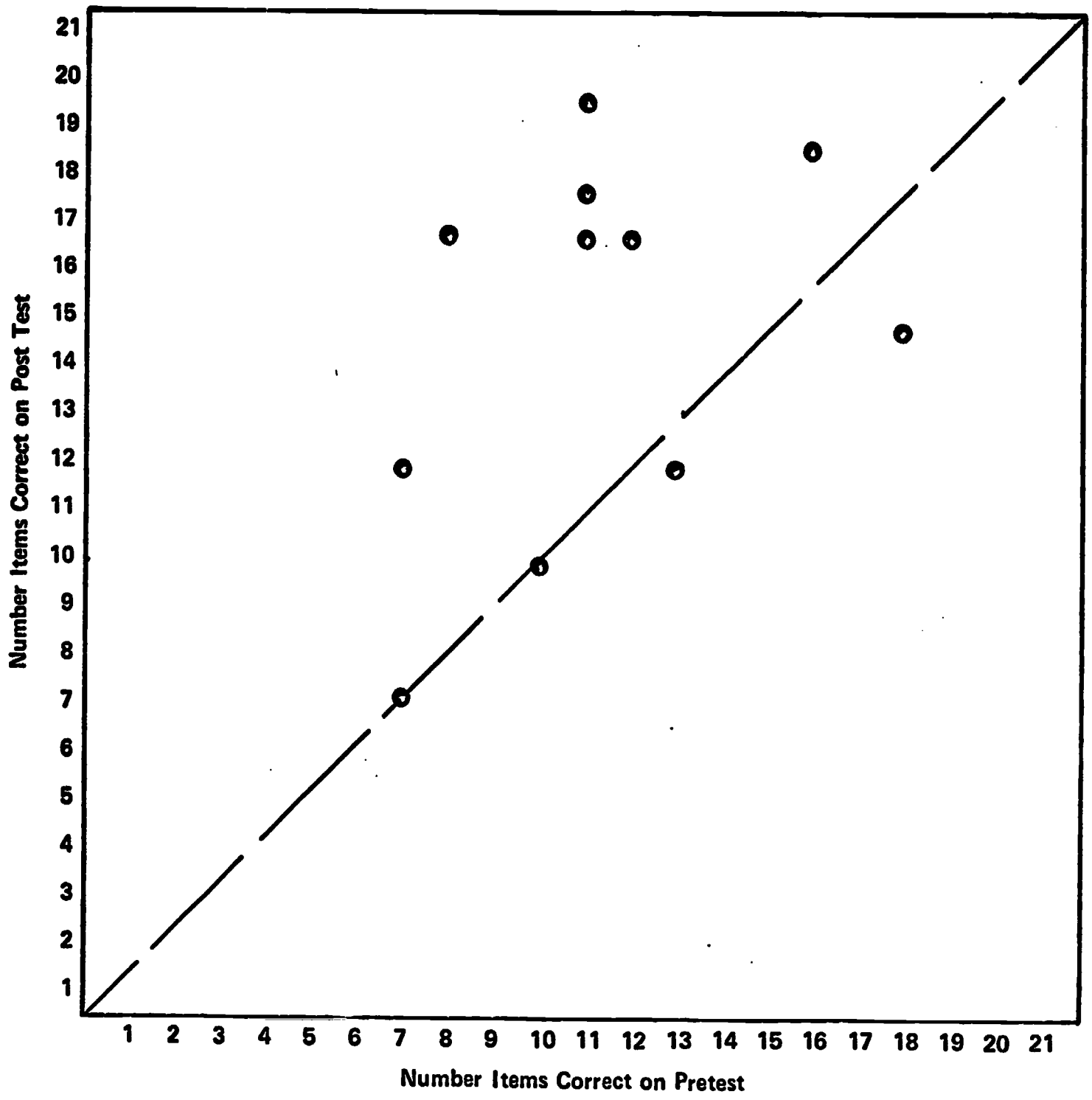


FIGURE 4

Number of items correct on post test as a function of number of items correct on the pretest for the Branched Group.

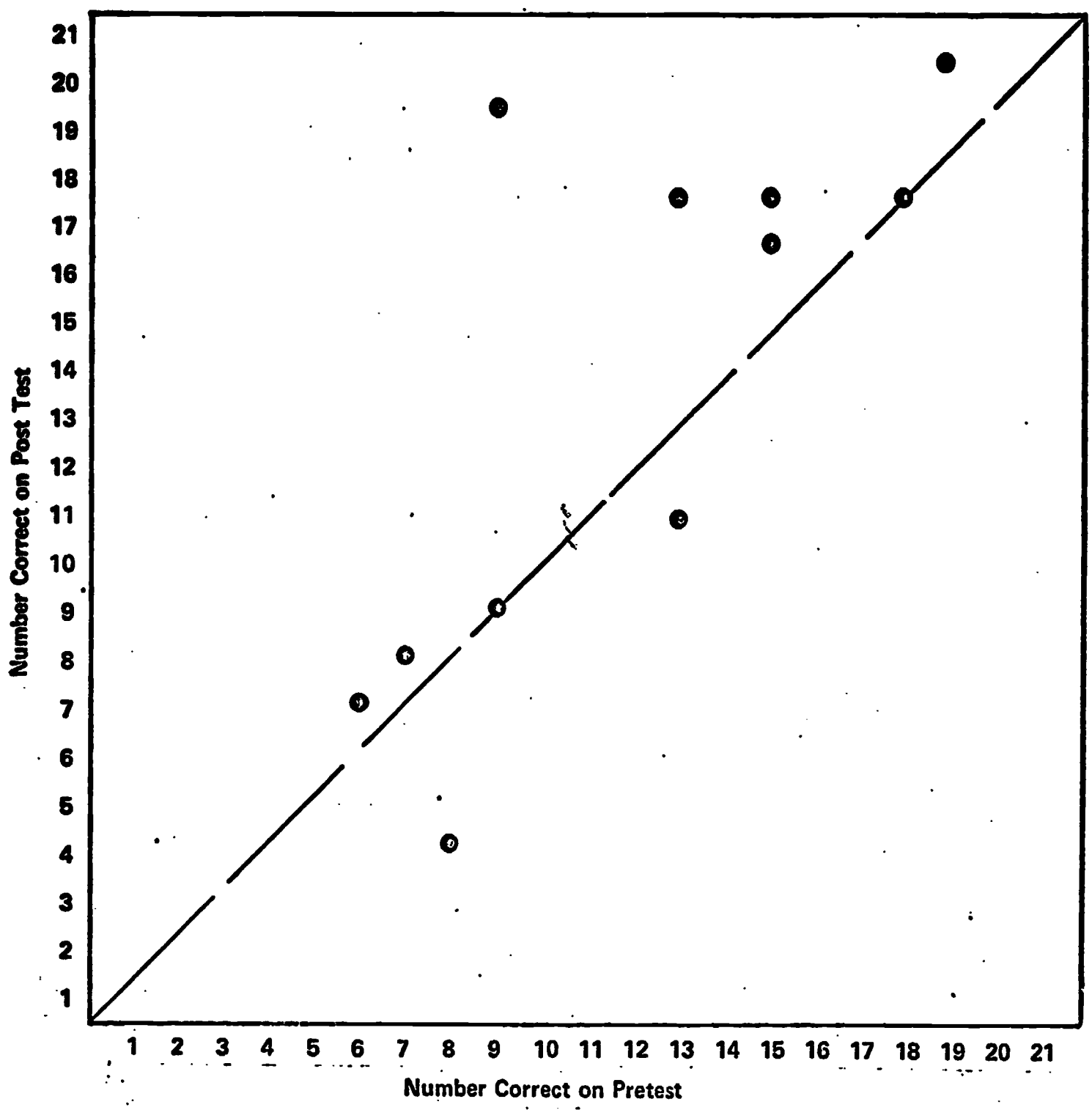


FIGURE 5

Number of items correct on post test as a function of number of items correct on the pretest for the Yoked Group.

RECEIVE THE SAME SCORE AND 2 Ss SCORE LOWER ON THE POSTTEST THAN THEY DID ON THE PRETEST. POSTTEST SCORES FOR THE BRANCHED GROUP RANGED FROM 7 TO 20 WHILE THE POSTTBET SCORES FOR THE YOKED GROUP RANGED FROM 4 TO 21. BOTH FIGURE 4 AND 5 DIFFER IN PATTERN FROM FIGURE 3. NEITHER SHOWS THE CLUSTERING NEAR THE TOP OF THE POSTTEST THAT IS A SIGN OF AN EFFECTIVE PROGRAM.

ERRORS: A COMPARISON OF ERRORS OVER THE LINEAR PORTION OF THE PROGRAM IS AN ADDITIONAL TEST OF THE EFFICACY OF THE DIFFERENT PROGRAM SEQUENCES. IT SHOULD BE REMEMBERED THAT THE LATTER PORTION OF THE PROGRAM FORMS THE CRITERION ITSELF. TO OBTAIN A COMPARABLE MEASURE FOR ALL THREE GROUPS THE AVERAGE ENTERING POINT FOR THE BRANCHED AND YOKED GROUPS WAS DETERMINED. THE ERROR DATA FOR THE LINEAR GROUP WAS TAKEN ONLY FROM THE ITEMS BEYOND THE AVERAGE ENTERING POINT (ITEMS 184 TO THE END OF THE PROGRAM). COMPARISONS OF THE NUMBER OF ITEMS ON WHICH ERRORS WERE MADE, THE TRADITIONAL ERROR RATE OF PROGRAMMED INSTRUCTION, SHOW RESULTS QUITE SIMILAR TO THE POSTTEST PERFORMANCES. THERE WAS NO STATISTICALLY SIGNIFICANT DIFFERENCE BETWEEN THE BRANCHED AND YOKED GROUPS WITH RESPECT TO ERROR DATA EITHER FOR THE FIRST RESPONSE ERRORS (ERROR RATE) OR TOTAL RESPONDING, INCLUDING PERSEVERATIVE OR REPEATED ERRORS. HOWEVER, THE LINEAR GROUP WAS SIGNIFICANTLY SUPERIOR TO BOTH THE BRANCHED AND THE YOKED GROUPS ON BOTH OF THESE ERROR MEASURES.

TIME TO COMPLETE THE PROGRAM: TIME TO COMPLETE THE PROGRAM WAS, NOT SURPRISINGLY, SENSITIVE TO THE NUMBER OF ITEMS RECEIVED AS WELL AS THE NUMBER OF ERRORS. THE LINEAR GROUP TOOK SIGNIFICANTLY MORE TIME TO COMPLETE THE PROGRAM THAN EITHER THE BRANCHED OR YOKED GROUP, BUT THE LINEAR GROUP SPENT SIGNIFICANTLY LESS TIME TO ANSWER INDIVIDUAL ITEMS CORRECTLY.

Discussion

Since the branched and yoked groups differed only in respect to whether or not the sequence was adaptive to the individual, the yoked group provided a measure of the degree to which adaptation to individual differences in the form used in this study improved learning. This measurement indicated that there was no advantage in the adaptive process in this instance. It is of course possible, even likely, that individualization would provide superior mastery under some conditions, or some types of tasks, or for some variety of individual differences. But such an advantage for individualization should no longer be taken as obvious. Claims for such advantages should be accepted only when demonstrated through the use of a yoked control or other suitable control procedure.

In fact, the data have generally lent scant support for the usefulness of individualization. Studies which have compared branching and linear programs have generally yielded negative results (cf. Holland, 1965). In summarizing the situation Gage and Unruh (1967) wrote, "the fact is that, despite several decades of concern with individualization, few if any striking results have been reported (p.368)." Moreover, Bracht (1970) explored the literature for interactions between treatments and aptitudes. Of 108 experiments, only five had significant results. Cronbach (1967) suggested that the very nature of branching as microadaption with its many microdecisions makes adequate evaluation of each branching rule almost impossible. Cronbach goes on to suggest that the best advice to teachers given the current state of individualization is not to attempt to treat children differently. The persistence of evangelical papers for the adaptive process as in individualization of instruction or computer-assisted instruction is hard to comprehend in the face of such general lack of support from research findings. Moreover, the expenditure of millions of hours and the work

OF MANY WRITERS IN PREPARING EDUCATIONAL MATERIALS WHICH HAVE AS THEIR PRINCIPAL FEATURE THE ADAPTATION TO INDIVIDUAL DIFFERENCES MIGHT BE CONSIDERED AN EXERCISE IN SUPERSTITIOUS BEHAVIOR GIVEN THE CURRENT STATE OF SCIENTIFIC FINDINGS CONCERNING THE ADAPTIVE PROCESS.

YET THE PROPOSITION THAT THERE SHOULD BE MUCH GAIN BY TAILORING EDUCATIONAL PROCEDURES TO THE INDIVIDUAL ACHIEVEMENT, APTITUDE OR STYLE OF THE LEARNER APPEARS TO BE A HIGHLY REASONABLE PROPOSITION. IT WOULD SEEM TO BE ALMOST CERTAINLY THE CASE THAT IN SOME INSTANCES, OR UNDER SOME CONDITIONS, SUCH ADAPTATION WOULD PRODUCE SUPERIOR LEARNING. WHAT IS VERY MUCH NEEDED IS ANALYTIC RESEARCH TO DETERMINE THE VARIABLES WHICH WOULD RENDER ADAPTATION MORE OR LESS EFFECTIVE. THE NATURE OF TASKS, THE NATURE OF INDIVIDUAL DIFFERENCES AND OTHER CONDITIONS WHICH WOULD PROVIDE THE EXPECTED ADVANTAGE FOR ADAPTIVE PROGRAMS SHOULD BE EXPERIMENTALLLY DETERMINED. BUT MOST IMPORTANT, ANY MATERIAL ALLEGED TO HAVE ITS EFFECTIVENESS THROUGH ADAPTING TO INDIVIDUAL DIFFERENCES SHOULD HAVE TO DEMONSTRATE THIS ADVANTAGE THROUGH THE USE OF A YOKED CONTROL.

SUMMARY

THIS EXPERIMENT WAS DESIGNED TO INVESTIGATE THE POSSIBLE FACILITATING EFFECTS ON PERFORMANCE OF ADAPTING TO INDIVIDUAL DIFFERENCES IN A FINELY-GRADED, SINGLE-SKILL PROGRAM THREE TYPES OF ITEM SEQUENCES WERE USED. THE LINEAR GROUP RECEIVED THE PROGRAM IN ITS ORIGINAL LINEAR SEQUENCE. EACH MEMBER OF THE BRANCHED GROUP ENTERED THE PROGRAM AT THE POINT DETERMINED BY HIS PERFORMANCE ON THE BRANCHING ITEMS. EACH YOKED SUBJECT WAS PAIRED RANDOMLY WITH A MEMBER OF THE BRANCHED GROUP AND RECEIVED THE ITEM SEQUENCE, INCLUDING BRANCHING ITEMS, DETERMINED BY THE PERFORMANCE OF HIS BRANCHED PARTNER. THE YOKED GROUP PROVIDED A CONTROL FOR THE ADAPTING PROCESS. THE ONLY DIFFERENCE BETWEEN THE BRANCHED AND YOKED GROUPS WAS THAT THE ITEM SEQUENCES WERE

ADAPTIVE TO AND APPROPRIATE FOR THE BRANCHED Ss AND NOT FOR THE YOKED Ss. THE BRANCHED AND YOKED GROUPS DID NOT DIFFER ON ANY OF THE DEPENDENT VARIABLES. THUS NO GAIN COULD BE ATTRIBUTED TO THE ADAPTIVE PROCESS. THE MERITS OF ADAPTINF TO INDIVIDUAL DIFFERENCES SHOULD NO LONGER BE ACCEPTED ON FACE VALIDITY. A YOKED CONTROL IS NECESSARY TO EVALUATE THE EFFECTIVENESS OF AN INDIVIDUALIZED PROGRAM.

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